SUPPORT FOR THE AMENDMENTS

Support for the amendment of Claims 8 and 9 is found in Claim 1 and on page 4, lines 11-13, in the specification.

Claims 1-6, 8-13 and 16-18 and 20-24 are active. Claims 15, 19, 25 and 26 are withdrawn.

REMARKS/ARGUMENTS

The claimed invention provides a photovoltaic device, comprising a composition of carbon nanotubes and of at least one organic hole conductor, wherein the band gap of said carbon nanotubes lies in the range of from about 0.5 to about 1 eV.

The rejection of Claims 1-4, 6, 8-10, 13, 16-18 and 21-24 under 35 U.S.C. 102(b) or in the alternative under 35 U.S.C. 103(a) over Kymakis et al. (Applied Physics Letters, American Institute of Physics. New York, Us vol. 80, no. 1,7, pages 112-114) with support of Dukovic et al. (Structural Dependence of Excitonic Optical Transitions and Band-Gap Energies in Carbon Nanotubes, Nano Letters, Vol. 5, No. 11 (pp 2314-2318) 2005) is respectfully traversed.

Kymakis describes a photovoltaic device containing poly(3-octylthiophene) and single walled carbon nanotubes. Kymakis is silent with respect to describing a band gap energy for the single-walled carbon nanotubes utilized in the described photovoltaic device. Nowhere does this reference disclose or suggest carbon nanotubes having a band gap from about 0.5 to about 1 eV.

The Office has pointed to description in Kymakis of SWNT's having a diameter of 1.4 nm (Official Action dated February 19, 2010, page 4, last paragraph) and employed equation (4) from Dukovic to estimate a band gap for the Kymakis SWNTs.

By substituting the value of 1.4 nm into Equation (4) of Dukovic, the Office alleges that the SWNTs of Kymakis would have a band gap of 0.978 eV. However, Applicants submit that equation (4) of Dukovic is not applicable as the Office suggests to predict the band gap of the Kymakis SWNTs.

Dukovic describes an investigation of the structural dependence of band gap energies in carbon nanotubes. In Figure 3 (b), experimentally determined band gap energies are plotted against the reciprocal diameter of the carbon nanotubes. Equation (4) is a mathematical fit for these experimental data. However, Applicants note that while it is known that the band gaps of carbon nanotubes are dependent on the tube diameter, it is also conventionally known that other factors also influence the value of the band gap. In particular, the chirality of the carbon nanotubes must be considered. Applicants submit in an attached IDS an article by Weisman et al., Applied Physics A (2004), 78, 1111-1116. As indicated on page 1111, col. 2, lines 17-21:

> Simple theoretical models predict that tubes for which n=m ("armchair" structures) are metallic, with a finite density of states at the Fermi level. Others for which n - m is evenly divisible by 3 should be semi-metals, with very small band gaps. Finally, the remaining SWNT are predicted to be semiconductors, with significant band gaps that depend on tube diameter **and chiral angle**. (Bold added for emphasis)

As neither reference describes the chirality character of the carbon nanotubes, there is no indication that the carbon nanotubes of Dukovic and Kymakis have the same chirality, and the experimental descriptions of the documents are insufficient to support such a conclusion. Applicants note, that, in fact, the SWNTs used in the two reference studies were prepared by completely different methods (arc discharge method vs. HiPCO method). Thus, Applicants submit that one of ordinary skill would not expect that the respective nanotubes would be similar in all their characteristics, including chirality.

Consequently, applicants submit that Equation (4) of Dukovic cannot be used to make meaningful predictions of the band gap of the SWNTs described by Kymakis. Applicants further submit that any predictions based on Equation (4) would be mere speculation, because significant extrapolation of the data plotted in Figure 3 (b) of Dukovic would be necessary. A value of 1.4 nm corresponds to a $1/d_t$ value of 0.71 which is not shown in Figure 3(b).

Accordingly, Applicants submit that a conclusion based on Equation (4) of Dukovic that the SWNTs of Kymakis have a band gap falling within the range of 0.5 to 1 eV is improper. Applicants remind the Examiner that the articles submitted in the IDS filed with the Response to the previous Official Action were for the purpose of demonstrating a wide range of band gap values possible in carbon nanotubes. The references were not cited as methods of absolute measurement of band gap. Dukovic clearly shows a large discrepancy in band gap values depending on the method of determination (page 2317, Col. 2) and also describes a relationship in value to method of measurement (e.g., see Col. 2, paragraph beginning at line 25).

In view of all the above, Applicants submit that Kymakis as supported by Dukovic does not explicitly nor inherently describe all the elements of the present invention. Therefore, Applicants submit that the cited combination of references can neither anticipate, nor render the claimed invention obvious and withdrawal of the rejection of Claims 1-4, 6, 8-10, 13, 16-18 and 21-24 under 35 U.S.C. 102(b) or in the alternative under 35 U.S.C. 103(a) over Kymakis with support of Dukovic is respectfully requested.

The rejection of Claim 5 under 35 U.S.C. 103(a) over Kymakis with support of Dukovic and further in view of Tsukamoto et al. (JP 2003-096313) is respectfully traversed.

Claim 5 directly depends from Claim 1 and includes all the description of the independent claim. The deficiencies of the primary reference combination relative to anticipating and/or rendering obvious the invention described in Claim 1 and claims

dependent thereon is described above. Tsukamoto neither discloses nor suggests a device according to the claimed invention wherein a band gap of said carbon nanotubes lies in the range of from about 0.5 to about 1 eV and therefore does not cure the deficiencies of the primary references.

Tsukamoto describes a Field Effect Transitor wherein a composite of carbon nanotubes and organic polymer is used as a semiconductor. This reference is silent with respect to a band gap for the carbon nanotubes and as carbon nanotubes are generally known to have band gaps of 3-14 meV, a band gap of 0.5 to about 1 eV cannot be inherent to the description of this reference. Accordingly, withdrawal of the rejection of Claim 5 under 35 U.S.C. 103(a) over Kymakis with support of Dukovic and further in view of Tsukamoto is respectfully requested.

The rejection of Claims 11 and 12 under 35 U.S.C. 103(a) over Kymakis with support of Dukovic and further in view of Forrest et al. (U.S. 6,451,415) is respectfully traversed.

The deficiencies of each of the cited primary reference combination has been described above. Forrest describes photodetector organic photosensitive optoelectronic devices having multilayer structures and an exciton blocking layer. This reference is cited to show a multilayer structure. However, Forrest does not disclose or suggest multilayers containing carbon nanotubes having a band gap in the range of from about 0.5 to about 1 eV and therefore Forrest does not cure the basic deficiencies of the primary reference combination. Withdrawal of the rejection of Claims 11 and 12 under 35 U.S.C. 103(a) over Kymakis with support of Dukovic and further in view of Forrest is respectfully requested.

The rejection of Claim 20 under 35 U.S.C. 103(a) over Kymakis with support of Dukovic and further in view of Ganzorig et al. (Alkali metal acetates as effective electron injection layers for organic electroluminescent device," Materials Science and Engineering B,

Elsevier Sequoia, Lausanne, Ch, vol. 85 no. 2-3, 22 August 2001 (2001-08-22), pages 140-143) is respectfully traversed.

Ganzorig is cited to show a coating layer of alkali metal acetate of fluoride on an electrode. This reference describes a coating applied at the interface of an aluminum/tris(8-hydroxyquinoline)aluminum electrode/transfer layer. Nowhere does Ganzorig disclose or suggest a composite of carbon nanotubes and of at least one organic hole conductor, wherein the band gap of the carbon nanotubes lies in the range of from about 0.5 to about 1 eV.

In view of the above, Applicants respectfully submit that Ganzorig does not cure the basic deficiency of Kymakis with support of Dukovic previously described, and therefore, the cited combination of references cannot render the claimed invention obvious. Accordingly, withdrawal of the rejection of Claim 20 under 35 U.S.C. 103(a) over Kymakis with support of Dukovic and further in view of Ganzorig is respectfully requested.

The rejection of Claims 4 and 5 under 35 U.S.C. 112, second paragraph, is respectfully traversed.

Applicants submit that the term "a composition of carbon nanotubes" of Claim 1 is a generic description of carbon nanotubes which is known to one of ordinary skill in the art to encompass various types of carbon nanotubes, including metallic and semiconducting forms and/or single or multi walled tubes. Applicants respectfully point to the introductory paragraphs of the articles by Baughman and Ghosh provided in the IDS submitted with the Response filed on January 19, 2010. Therefore, Claims 4 and 5 are further describing the invention be providing more specific description of the composition of carbon nanotubes.

The MPEP 2173.02 states:

> The essential inquiry pertaining to this requirement is whether the claims set out and circumscribe a particular subject matter with a reasonable degree of clarity and particularity. Definiteness of claim language must be analyzed, not in a vacuum, but in light of:
>
> (A) The content of the particular application disclosure;
>
> (B) The teachings of the prior art; and
>
> (C) The claim interpretation that would be given by one possessing the ordinary level of skill in the pertinent art at the time the invention was made.

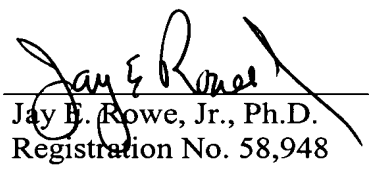
Applicants respectfully submit that as described above, the descriptions of the cited references show that one of ordinary skill would recognize the composition of carbon nanotubes as a generic term comprising the mixtures described in Claims 4 and 5. Accordingly, Applicants submit that Claim 1 does meet the requirements of 35 U.S.C. 112, second paragraph and withdrawal of the rejection of Claims 4 and 5 under 35 U.S.C. 112, second paragraph, is respectfully requested.

The objection to Claims 8 and 9 is believed obviated by appropriate amendment. Both claims are herein amended to describe "organic" hole conductor which is consistent with the description of Claim 1 and is the amendment requested by the Examiner.

Applicants respectfully submit that the above-identified application is now in condition for allowance and early notice of such action is earnestly solicited.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.



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